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Inter-Departmental Memorandum

Date: May 28th, 2016

To: Hydraulics Division

From: State Hydraulics Engineer
Rachel Westerfield, PE, CFM

Subject: Hydraulic Design Guideline for Rock Riprap at Bridge Abutments

Guidance provided in “*Bridge Scour and Stream Instability Countermeasures*, Hydraulic Engineering Circular No. 23 (HEC-23) – Volume 2 – Design Guideline 14 Rock Riprap at Bridge Abutments” should be followed for proper hydraulic design, sizing, and placement of rock riprap at bridge abutments.

Riprap placed at abutments for scour protection should be placed with a **horizontal apron** extending a distance of twice the flow depth or 25 feet whichever is less from the toe of the abutment into the bridge waterway. The downstream coverage should extend back from the abutment twice the flow depth or 25 feet whichever is larger, and the upstream coverage should extend back 10 feet to protect the embankment. Where guide banks are recommended, the horizontal apron should extend a distance of 3 feet. See Figure 1: Plan view of the extent of rock riprap apron. Site conditions may warrant modifications to these guidelines, and are subject to approval from the State Hydraulics Engineer.

Abutment slopes should be protected with rock riprap to an elevation 2 feet above the design flood elevation. Abutment slopes at hydraulic crossings are typically 2H:1V unless otherwise specified by MDOT Geotechnical Branch.

Once a design size of rock is established per HEC-23, a standard size class should be selected and recommended from MDOT's standard riprap sizes (i.e. 300 lb., 500 lb., etc). If calculations show that the rock size should be larger than 500 lb., approval is needed from the State Hydraulics Engineer.

The rock riprap thickness should not be less than the larger of either 1.5 times D_{50} or D_{100} . **Where 300 lb. rock is recommended, the thickness should be 2.5' according to the D_{100} . If calculations show that the design size of rock is less than 300 lb., 300 lb. rock should still be recommended unless approved by the State Hydraulics Engineer. The rock**



riprap thickness should be increased by 50% when it is placed under water to provide for the uncertainties associated with this type of placement. The top surface of the apron should be at least flush with the existing grade of the floodplain, see Figure 2. This is recommended because the layer thickness of the riprap could block a significant portion of the floodplain flow depth (reducing bridge conveyance) and could generate significant scour around the apron. The apron thickness may also be increased to protect the edge of the apron from contraction scour, long-term degradation and/or channel migration. **If abutment scour is to be removed from estimating scour elevations due to countermeasure placement, the top of the apron would have to be located below the contraction scour elevations.**

Underlying geotextile or granular filter material must be recommended. Details and specifications should only be included when requested.

Design, documentation, details and drawings for countermeasures shall be provided for the preliminary hydraulic design unless otherwise specified. Standard MDOT forms should be included with any applicable recommendations stating the riprap extents, design elevations, thickness, and underlying filter material required.

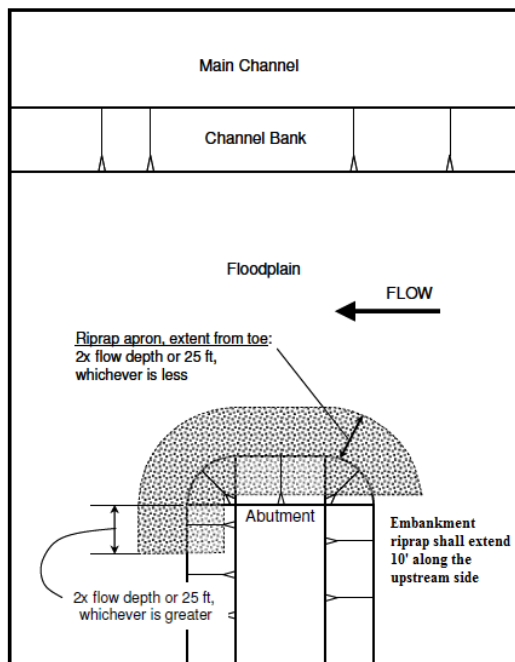


Figure 1: Plan view of the extent of rock riprap apron

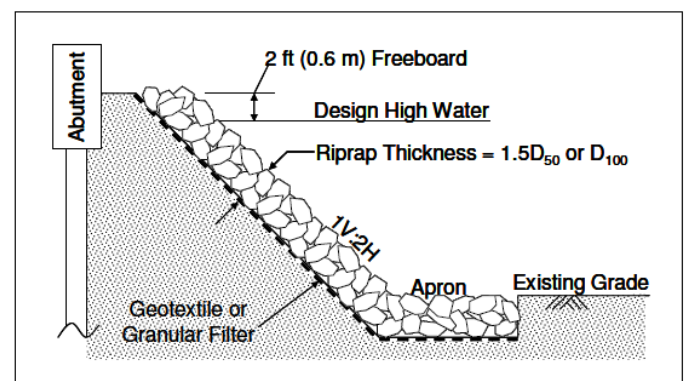


Figure 2: Typical cross section for abutment riprap

If there are any questions, please advise.

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